

**METHOD OF COATING A POLYMER COMPONENT WITH
AN NBC RESISTANT COATING**

CROSS-REFERENCE TO RELATED APPLICATION

The present application claims the benefit of and priority to United Kingdom Patent Appln. Ser. No. 0224674.2, filed on October 23, 2002, the entire contents of which are incorporated herein by reference.

BACKGROUND

1. **Technical Field**

This invention relates to a method of coating a component made from a polymer with a Nuclear, Biological or Chemical (NBC) resistant coating and a component or material made by said method. The invention is however more particularly but not exclusively concerned with the manufacture of diaphragm valves for use in respirators or other equipment for use in an NBC environment.

2. **Discussion of Related Art**

Known NBC resistant diaphragms are made of a natural or synthetic rubber material which needs to be very thin if they are to work satisfactorily. A problem with these diaphragms however is that, over a period of time, the NBC agents can

penetrate the rubber due to absorption and they also become brittle at low temperatures which can have fatal consequences.

It is an object of the invention therefore to provide an NBC resistant material which remains pliable at very low temperatures.

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SUMMARY

According to one aspect of the invention, there is provided an NBC resistant material comprising a non-NBC resistant polymeric layer having an inside and outside surface with a coating of NBC resistant material on one or both
10 of said surfaces.

Preferably, the polymeric layer is vulcanised silicone rubber and the coating NBC resistant material is butyl, most preferably a butyl rubber material.

Whilst silicone rubber coated with butyl will provide an excellent NBC resistant material which remains pliable even at very low temperatures, until now
15 it has not been possible to coat silicone with a butyl covering as it could not be made to adhere to it as the two materials are not compatible.

However, the preferred method of the invention solves this problem by providing a method of applying a coating of butyl to a surface on a layer of silicone rubber comprising the steps of subjecting the silicone rubber surface to be
20 coated to a high frequency and high voltage corona discharge to change said surface and provide a keying surface thereon and applying the coating of butyl thereto.

In the preferred method, the silicone rubber layer is washed with soapy water, rinsed and dried prior to the application thereto of the corona discharge.

Preferably, the butyl is sprayed onto the keying surface on the silicone rubber layer. If more than one coat of butyl is sprayed onto the silicone layer, each coat needs to be allowed to dry before the application of a subsequent layer.

In the preferred method, the silicone rubber material coated with one or more butyl layers is placed in a preheated oven and vulcanised.

Preferably, the oven is preheated to a temperature above about 200°C, most preferably above 200°C and the vulcanised process takes place for approximately 30 minutes.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

According to one aspect of the invention, there is provided an NBC resistant material comprising a non-NBC resistant polymeric layer having an inside and outside surface with a coating of NBC resistant material on one or both of said surfaces.

A preferred method of applying an NBC resistant material, most preferably a butyl rubber material, to a surface on a layer of non-NBC resistant polymeric material, most preferably silicone rubber, will now be described. By way of example only, the method includes the following steps:

- a. making a silicone rubber diaphragm valve in known manner by a moulding process which vulcanised the rubber material;

- b. removing the moulded diaphragm from the mould and carefully washing the moulded diaphragm with soapy water;
- c. rinsing the washed diaphragm using cold clean water and laying out the rinsed diaphragm to dry;
- 5 d. exposing the surface of the now clean and dry diaphragm, to which an NBC resistant material is needed to be applied, to a high frequency and high voltage corona discharge which changes the surface and provides a keying area thereon onto which the NBC resistant material can be applied;
- e. placing the treated and/or exposed diaphragm on a support member
- 10 for subsequent treatment and processing;
- f. spraying the treated and/or exposed diaphragm with a butyl solution to coat one or both surfaces (i.e., an inside or an outside surface) thereof with the NBC resistant material (several coats can be applied to increase the overall thickness of the coat allowing a drying time of approximately 10 minutes between
- 15 each coat);
- g. placing the diaphragm, coated with butyl, in an oven preheated to over 200°C for approximately 30 minutes to vulcanise the butyl;
- h. removing the vulcanised diaphragm from the oven and allowing the vulcanised diaphragm to cool; and
- 20 i. once the vulcanised diaphragm is cool, dusting the diaphragm with talcum powder and carefully removing the diaphragm from the support to complete the manufacturing process.

It will be appreciated that when the air adjacent the surface of the diaphragm to be coated is subjected to the high voltage corona discharge, the free electrons therein accelerate and ionise the gas. When the corona discharge is very strong, collisions between high velocity electrons with molecules of gas, result in
5 no loss in momentum and electron avalanching occurs.

When the polymer component made of plastic or rubber is placed in the corona discharge path, the electrons generated during the discharge impact on the component with energy levels 2 or 3 times that necessary to break the molecular bond on the surface of most substrates and very reactive free radicals are created.
10 These free radicals in the presence of oxygen react rapidly to form various chemical functional groups on the component which are the most effective at increasing surface energy and enhancing chemical bonding to other substrates such as carbonyl, carboxyl, hydroperoxide and hydroxyl groups.

A major advantage of surface treating a component with (i.e., a diaphragm)
15 a high voltage corona discharge is that it modifies only the surface characteristics of the component without affecting the material bulk properties thereof.

A diaphragm made in accordance with the invention has been found to remain pliable and work satisfactorily down to temperatures as low as -50°C .

Although the present invention has been described with respect to a
20 preferred method, it will be readily apparent to those having ordinary skill in the art to which it appertains that changes and/or modifications may be made thereto without departing from the spirit or scope of the invention.